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SOLDIER SYSTEM MODELING AND INTEGRATED UNIT SIMULATION SYSTEM (IUSS)

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U.S. Army Natick Soldier Research, Development and Engineering Center
Natick, Massachusetts 01760-5020

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14. ABSTRACT

This paper consists of two separate presentations given by the U.S. Army Natick Soldier Research, Development and Engineering Center (NSRDEC) to the Technology Base Executive Steering Committee (TBESC) in December 1992 at the U.S. Army Infantry School (USAIS) in Ft. Benning, GA. The first presentation included an update on the efforts and accomplishments of the TBESC Soldier System Modeling Working Group during the previous 8 months and recommendations on issues related to Soldier System modeling/simulation support of the Research and Development Community. The second presentation was an update on NSRDEC’s efforts to apply the Integrated Unit Simulation System (IUSS) to the problems of the Soldier System during the previous 8 months. The IUSS provided an open, extensible architecture for the unified representation of current and revolving aspects of the modern battlefield: threats, personnel. equipment, and environmental factors. The second presentation included a review of the objectives, approach, and philosophy of the IUSS, a more detailed review of the principal methodologies used by the IUSS, and a short demonstration of the system features.

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ALGORITHMS PERFORMANCE(HUMAN) COMPUTERIZED SIMULATION MODELS
SOLDIER SYSTEM INTEGRATED SYSTEMS MODELING AND SIMULATION
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IUSS(INTEGRATED UNIT SIMULATION SYSTEM) COMPUTER APPLICATIONS

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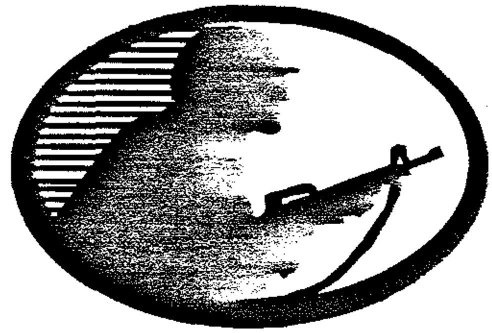
TBESC SOLDIER SYSTEM MODELING WORKING GROUP



JOHN A. O'KEEFE IV

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Title Slide

Good Morning, I'm John A. O'Keefe IV of the Concepts Analysis Division, Advanced Systems Directorate, U.S. Army Natick Research, Development and Engineering Center., the ad-hoc chairman of the Technology Base Executive Steering Committee (TBESC) Soldier System Modeling Working Group This briefing is intended to provide an update to the members of the TBESC on the efforts of the TBESC Soldier System Modeling Working Group that have occurred since the 15 April 1992 meeting of the TBESC.

BRIEFING OUTLINE

NATICK

- Soldier System Modeling Coordination
- TBESC Soldier System Modeling Working Group Accomplishments
- TBESC Soldier System Modeling Working Group Recommendations
- Summary

John A. O'Keefe/Natick/TBESC Meeting/3 Dec 92 Slide 2

Briefing Outline

Today, you will be provided with:

- A review of the Soldier System Modeling coordinating activities that have occurred since the 1 April 1992.
- The accomplishment of the TBESC Soldier System Modeling Working Group and
- The recommendations of the TBESC Soldier System Modeling Working Group on issues related to Soldier System modeling/simulation support of the Research and Development Community.

SOLDIER SYSTEM MODELING COORDINATION

NATICK

- **Natick/MRDC Human Performance Coordination Meeting**
- **DNA/IDA Soldier Performance Representation in Combat Models Meeting**
- **Natick/MRDC Human Performance Modeling Meeting**
- **20 October 1992 TBESC Soldier System Modeling Working Group Meeting**
- **23-24 November 1992 TBESC Soldier System Modeling Working Group Meeting**

Soldier System Modeling Coordination

Since the 15 April 1992 meeting of the TBESC meeting number of meetings addressing Soldier System modeling or simulation have been held. These meetings have included:

- Natick/MRDC Human Performance Coordination Meeting
- DNA/IDA Soldier Performance Representation in Combat Models Meeting
- Natick/MRDC Human Performance Modeling Meeting
- 20 October 1992 TBESC Soldier System Modeling Working Group Meeting
- 23-24 November 1992 TBESC Soldier System Modeling Working Group Meeting

During the Natick/MRDC meeting in June 1992 the need for coordination of the various human performance research and modeling efforts was agreed upon. As a result of this meeting a joint Natick/MRDC Human Performance Modeling meeting was held. During this two day meeting the project officers from MRDEC, AMC, ARI, and Office of the Surgeon General.

The DNA/IDA meeting brought together combat modelers from Lawrence Livermore National Laboratory, the U.S. Marine Corps Wargaming & Simulation Center, Defense Modeling and Simulation Office, IDA, DNA, TRAC, USAIS, and AMC to discuss the requirements for modeling dismounted soldier performance in high resolution force-on-force combat simulations.

Two meetings of the TBESC Soldier System Modeling Working Group and discussions have been held with Mr. Michael Bauman, Acting Director, TRAC, on the relationship between the IMIP and the TBESC Soldier System Modeling Working Group.

RECOMMENDATIONS TO APRIL 1992 TBESC MEETING

NATICK

- **Develop a Charter for the TBESC Soldier System Modeling Working Group**
- **Request the Establishment of a Joint Technical Coordination Group - Munitions Effectiveness (JTCG-ME) Soldier System Working Group**
- **Develop a Soldier System Modeling/Simulation Statement of Need**
- **Develop an Inventory of Soldier System Models, Algorithms and Simulations**
- **Coordinate the Efforts of the Infantry Model Improvement Program and the TBESC Soldier System Modeling Working Group to Identify:**
  - **The Capabilities of Current Models to Support Assessment of the Soldier System**
  - **The Deficiencies in Current Models**
  - **Recommend Changes to the Army Model Improvement Program to Address Deficiencies**

RECOMMENDATIONS TO APRIL 1992 TBESC MEETING

During the 15 April 1992 meeting of the TBESC the following recommendations that had been developed at the 1 April 1992 Research and Development Community's High Resolution Modeling Requirements to Support the Soldier System Meeting at Natick were presented.

- Establish a TBESC Soldier System Modeling Working Group to ensure analytical tools to assess the Soldier System are available

- Request establishment of a Joint Technical Coordination Group - Munitions Effectiveness (JTCG-ME) Soldier System Working Group

- The Deputy Under Secretary of the Army for Operations Research (DUSA-OR) initiate an Army Study to identify: the capabilities of current models to support assessment of the Soldier System; the deficiencies in current models; and recommend changes to the Army Model Improvement Program (AMIP) to address deficiencies.

ACCOMPLISHMENTS

NATICK

- Formation of TBESC Soldier System Modeling Working Group
- Review of Existing Army Database Efforts for Applicability to Soldier System Modeling Requirements
- Development of Strawman Soldier System Modeling/Simulation Needs Statement
- Development of Soldier System Model/Simulation/ Algorithm Inventory
- Assignment of Responsibility for Mapping of 3D Relationship to Human Performance/Battlefield Environment/ Equipment Characteristics Relationship to Soldier System Capability Hierarchy

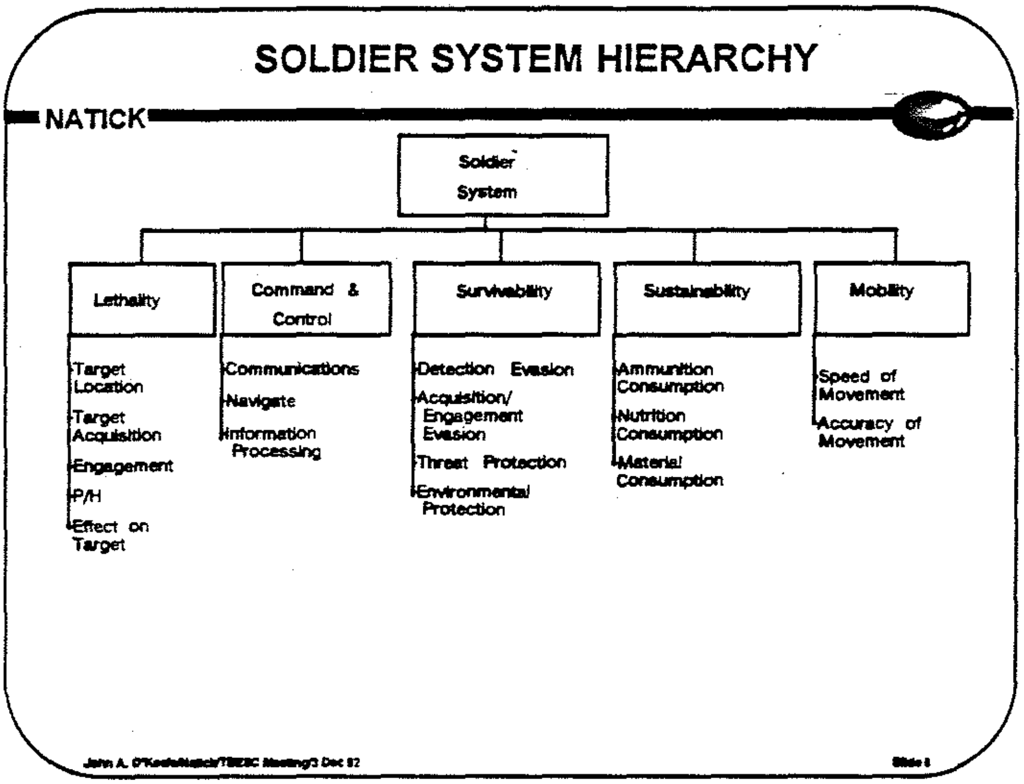
ACCOMPLISHMENTS

An ad-hoc TBESC Soldier System Modeling Working Group has been chaired by Natick and including representation from the Dismounted Warfighting Battle Laboratory, PM-Soldier, MRDC, TSM-Soldier and TRAC has been formed. The Modeling Working Group has drawn upon other organizations including AREDEC, U.S. Army Special Operations Command, STRICOM, ARI, ARL, U.S. Army Model Improvement and Study Management Agency (MISMA) and CECOM for assistance.

The Soldier System Modeling Working Group has reviewed existing Army database efforts in an attempt to identify an existing database that could meet the needs of Soldier System modeling. These database needs include storage of the following types of data: human performance; soldier vulnerability; soldier effectiveness; and soldier reaction to battlefield environments. No existing database was identified that could meet the requirements of Soldier System Modeling. Therefore, the TBESC Soldier System Modeling Working Group recommended that the TBESC request the establishment of a Joint Technical Coordination Group - Munitions Effectiveness (JTCG-ME) Soldier System Working Group.

The Dismounted Warfighting Battle Laboratory, working with the Foreign Science and Technology Center, the U.S. Army Special Operations Command and the TBESC Soldier System Modeling Working Group, has developed a Strawman Soldier System Modeling and Simulation Statement of Need. This Statement of Need is based upon a review of the current capabilities to model the infantry soldier and current/projected soldier system studies. In addition the members of the TBESC Soldier System Modeling Working Group have developed an inventory of Soldier System models, simulations, and algorithms.

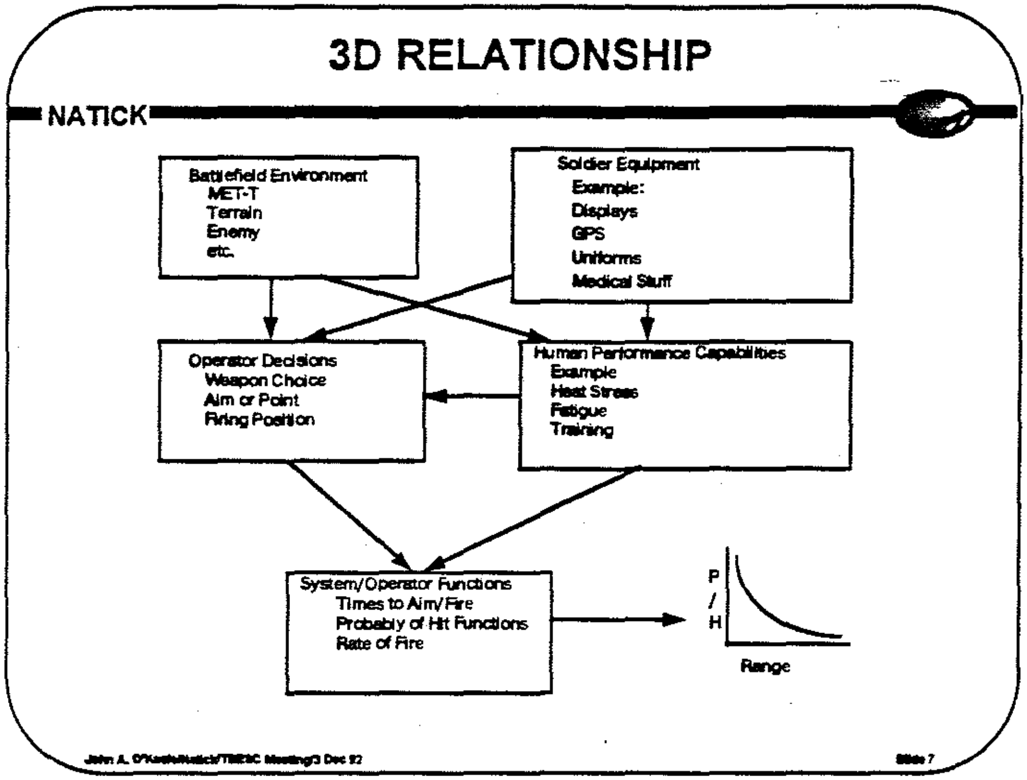
The TBESC Soldier System Modeling Working Group has established responsibility for mapping a 3 dimensional relationship of human performance, battlefield environment, and equipment characteristics to Soldier System capabilities.



Soldier System Hierarchy

Members of the Soldier Integrated Protective Ensemble (SIPE) Evaluation and Measures of Performance Teams in January 1992 developed a Soldier System Hierarchical Model, the top level of which is shown here. This model is based upon the five capability areas of the Soldier System, as identified in the Soldier Modernization Plan. These areas: Lethality, Command and Control, Survivability, Sustainability, and Mobility; were decomposed into the sub-capabilities shown here, and in some instances, those sub-capabilities were further refined into lower levels of detail.

This hierarchy serves as basis for focusing the work of the TBESC Soldier System Modeling Working Group. In particular, it has served as a frame work around which to develop a Statement of Need and to relate Battlefield Environment Soldier Performance Capabilities, and Soldier Equipment Characteristics.



3D Relationship

The Battlefield Environment, Soldier Performance Capabilities, and Soldier Equipment Characteristics interact with each other to affect the decisions and functions performed by soldiers. Representation of this three dimensional interaction is essential to modeling the contributions of each of the Soldier System capabilities to the effectiveness of the total Soldier System. A flow chart of an example three dimensional relationship for the Engagement sub-capability is shown here.

The lead responsibility for mapping this three dimensional relationship to the sub-capabilities of the Soldier System have been assigned to members of the Modeling Working Group. They are as follows:

• Lethality -- ARDEC.

•Mobility -- HRED, ARL

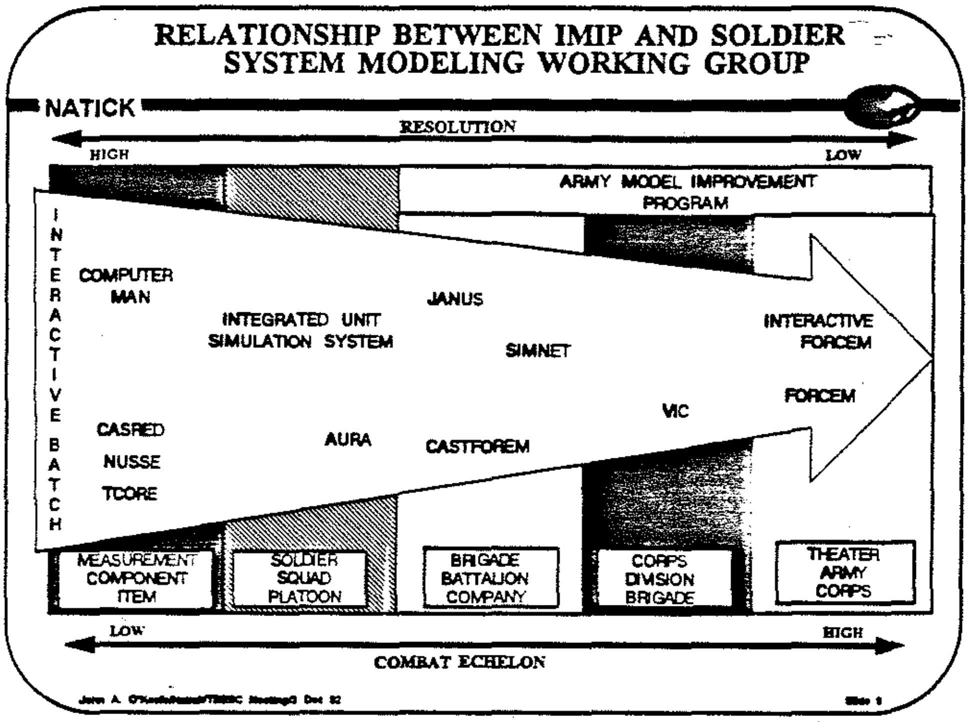
•Threat Protection sub-capability of Survivability -- Natick

•Environmental Protection sub-capability of Survivability USARIEM (MRDC)

The mapping of the Avoiding Detection and Avoiding Acquisition/Engagement sub-capability of Survivability were felt to be the Red Engagement, Acquisition, and Engagement sub-capabilities of Lethality. Therefore, by modeling the Red force's Engagement, Acquisition, and Engagement sub-capabilities of Lethality these two Blue force sub-capabilities can be modeled.

The mapping of the three dimensional relationship to the Soldier System Command and Control and Sustainability capabilities has been deferred until the mapping to the other capabilities is completed and the relationship of these two capabilities to the other Soldier System capabilities is better understood.

The initial mapping of the three dimensional relationship to the three Soldier System capabilities will be completed in March 1993.



Relationship Between IMIP and Soldier System Modeling Working Group

The relationship between the Infantry Model Improvement Program (IMIP), established in September 1992 by the Acting Director of TRAC, and the TBESC Soldier System Modeling Working Group, established following the April 1992 TBESC meeting, has been discussed with Mr. Michael Bauman, Acting Director, TRAC, and the members of the TBESC Soldier System Modeling Working Group.

The two groups are complementary and not duplicative. The IMIP is concentrating on Infantry High Resolution Force-On-Force Combat Models such as Janus and CASTFOREM. These models focus primarily on Company, Battalion, Brigade resolution element representations. The emphasis of the TBESC Soldier System Modeling Working Group has been models and simulation that range from the representation of squads and platoons. These models and simulations in general attempt to replicate detailed interaction of equipment/human performance and battlefield hazards/environments.

Coordinated activities of these two groups will identify the capabilities of current models to support assessment of the Soldier System, the deficiencies in current models, and recommend changes to the Army Model Improvement Program (AMIP) to address deficiencies.

Mr. Bauman and the members of the TBESC Soldier System Modeling Working Group agree that to facilitate this coordination between the two groups a charter for the Soldier System Modeling Working Group is needed.

RECOMMENDATIONS

NATICK

- **Develop a Charter for the TBESC Soldier System Modeling Working Group**
- **Request the Establishment of a Joint Technical Coordination Group - Munitions Effectiveness (JTCG-ME) Soldier System Working Group**
- **Develop a Soldier System Modeling/Simulation Statement of Need**
- **Develop an Inventory of Soldier System Models, Algorithms and Simulations**
- **Coordinate the Efforts of the Infantry Model Improvement Program and the TBESC Soldier System Modeling Working Group to Identify:**
  - **The Capabilities of Current Models to Support Assessment of the Soldier System**
  - **The Deficiencies in Current Models**
  - **Recommend Changes to the Army Model Improvement Program to Address Deficiencies**

Recommendations

The TBESC Soldier System Modeling Working Group has developed five recommendations to address the modeling requirements to support the Soldier as a System. The first is to develop a charter to formalize the Technology Base Executive Steering Committee (TBESC) Soldier System Modeling Working Group. This working Group will be chaired by Natick and include representation from PM-Soldier, MRDC, TSM-Soldier and TRAC. It will draw upon other organizations for assistance as necessary. The group will be responsible for identifying and reporting to the TBESC those actions required to ensure the availability of analysis tools necessary to support assessment and studies of the Soldier as a System.

The second recommendation is to request that the Chairman of the Joint Technical Coordination Group - Munitions Effectiveness (JTCG-ME) form a JTCG-ME working group on the Soldier as a System. The group will be chartered to collect and, where necessary, develop the data require to support modeling of the Soldier as a System. The data will be documented in a JTCG-ME manual and will be available to any organization performing Soldier System Modeling/Simulation.

The third recommendation is to develop a Soldier System Modeling and Simulation statement of need. This statement of need will serve to guide the efforts to develop models, algorithms and simulations to support Soldier System studies, analysis and development. Action on this recommendation has already been started by members of the Working Group. A strawman statement of need has been developed by the Dismounted Warfighting Battle Laboratory and reviewed by the Working Group.

The fourth recommendation is to develop an inventory of Soldier System models, algorithms and simulations. An initial inventory has been developed and is being used with the strawman statement of need to identify current soldier system modeling/simulation capabilities and gaps. Action on this recommendation has also been started. The initial inventory was completed 19 November 1992 and is currently being revised.

Finally the meeting recommended that the Infantry Model Improvement Program (IMIP) and the TBESC Soldier System Modeling Working Group coordinate their efforts to identify the capabilities/deficiencies of the current Army models to support assessment of the Soldier as a System and to recommend prioritized changes as necessary to the Army Model Improvement Program (AMIP) to address the identified deficiencies. The IMIP will focus on combat models and the TBESC will focus on R&D and human performance models and simulations.

SUMMARY

NATICK

- The Ability to Measure Small Unit Operability and Survivability as a Function of Soldier System Performance as it Exists and Evolves is Requisite to Ensure Success on Future Battlefields is Needed
- We are Leveraging Multi-Agency / Multi-Service Participation to Address Soldier System Modeling Needs (MRDC, ARL, STRICOM, Natick, AMSAA, TRAC, TRAC-WSMR, LLNL, DNA, IDA, Brooks AFB, CRDEC, USAIS, MISMA, ARI, NSWC, FSTC, etc)
- A Well Coordinated Effort Consistent with Battle Lab and DIS is being Pursued

Summary

In summation, TBESC Soldier System Modeling Working Group has been responding to the needs of the Soldier System to quantify potential benefits from evolving technologies. In particular, this response has resulted in the development of a Soldier System Modeling and Simulation Statement of Need, an Inventory of existing Soldier System Models, Simulations, and Algorithms and the mapping of a three dimensional relationship of Battlefield Environment, Soldier Performance Capabilities, and Soldier Equipment Characteristics to the Soldier System Capabilities.

GLOSSARY

AMSAA	US Army Materiel System Analysis Activity
ARDEC	US Army Armament Research, Development and Engineering Center
ARL	US Army Research Laboratories
ARI	US Army Research Institute
ARO	US Army Research Office
ASB	Army Science Board
Battelle	Battelle Memorial Institute
BRL	US Army Ballistic Research Laboratories (Now part of ARL)
Brooks AFB	US Air Force Human System Command and School of Aerospace Medicine
CRDEC	US Army Chemical Research, Development and Engineering Center
DARPA	Defense Advanced Research Projects Agency
DIA	Defense Intelligence Agency
DIS	Distributed Interactive Simulation
DNA	Defense Nuclear Agency
FSTC	Foreign Science and Technology Center
GWU	George Washington University
HEL	US Army Human Engineering Laboratories (Now part of ARL)
IDA	Institute of Defense Analyses
LLNL	Lawrence Livermore National Laboratories
MISMA	US Army Model Improvement Study Management Agency
MRDC	US Army Medical Research and Development Command
Nat'l Sim Center	National Simulation Center, Ft. Leavenworth, KS
Natick	Natick Research, Development and Engineering Center
OTSG	Office of The Surgeon General, US Army
Sandia NL	Sandia National Laboratories, Allen, New Mexico
SIPE	Soldier Integrated Protective Ensemble
STRICOM	US Army Simulation Training and Instrumentation Command
TBESC	Technology Base Executive Steering Committee
TRAC	US Army Training and Doctrine Command (TRADOC) Analysis Command
TRAC-WSMR	US Army TRAC - White Sands Missile Range
USACMLS	US Army Chemical School
USAIS	US Army Infantry School
USARCS	US Army Armor Center School
USAREUR	US Army Europe
WES	US Army Corps of Engineers Waterways Experimentation Station
West Point	US Military Academy, West Point

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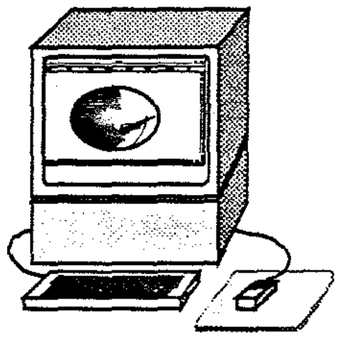
Integrated Unit Simulation System (IUSS)



CRAIG D. PORTER

PRESIDENT, SIMULATION TECHNOLOGIES, INC.

The Integrated Unit Simulation System

The US Army Natick Research, Development & Engineering Center (Natick), supported by Simulation Technologies, Inc. (STI) and others such as the Dismounted Warrior Battle Lab, is currently developing the Integrated Unit Simulation System (IUSS) to provide a comprehensive analysis environment for the evaluation of Soldier Systems' survivability and effectiveness. The IUSS provides an open, extensible architecture for the unified representation of current and evolving aspects of the modern battlefield: threats, personnel, equipment, and environmental factors.

BRIEFING OUTLINE

Natick

- IUSS Review
- FY92 Accomplishments
- Demonstration of the System
- Methodology Discussion
- Summary: The IUSS Addressing the Needs of the Soldier

Briefing Outline

This briefing provides the Technology Base Executive Steering Committee(TBESC) with an update of Natick's efforts to develop and apply the IUSS to the problems of the Soldier System. The briefing begins with a review of the objectives, approach, and philosophy of the IUSS, followed by a discussion of what Natick and its support contractors have accomplished in fiscal 92. The core of the briefing examines the principal methodologies employed by the IUSS and illustrates these in a short demonstration of system features. The briefing concludes with a wrap-up of system features and a summary of the issues involved in ensuring that the IUSS will, in fact, address the needs of the Soldier.

IUSS REVIEW

Natick

- IUSS Effort Executive Summary
- Evolution of the Soldier System
- Modeling the Soldier as a System
- IUSS Highlights

IUSS Review

This review of the IUSS includes an executive summary of the effort, a short synopsis describing the system, its goal and the scope of the effort. This is followed by a description of the parallels between the evolution of the Soldier System concept and the requirement for, and development of, an integrated simulation to support related R&D initiatives. This simulation, modeling the Soldier as a System, permits assessment of the potential benefits of R&D products as measured by their effects on the performance of both the individual soldier and his unit.

The review of the IUSS concludes with a look at system highlights, key design principles and operational characteristics.

IUSS EXECUTIVE SUMMARY

Natick

- DESCRIPTION:
  An Open, Extensible Architecture Providing A Comprehensive Analysis Environment for the Evaluation of Soldier Systems' Survivability and Effectiveness
- GOAL:
  Ability to Measure Small Unit Operability and Survivability as a Function of Soldier System Performance Currently and for the Future
- SCOPE:
  A Well Coordinated Effort Consistent with Battle Lab and DIS - Multi-Agency / Multi-Service Participation to Address Soldier System Modeling Needs (NRDC, ARL, STRICOM, Natick, AMSAA, TRAC, TRAC-WSMR, LLNL, DNA, IDA, Brooks AFB, CRDEC, USAIS, MISMA, ARI, NSWC, FSTC, etc.)

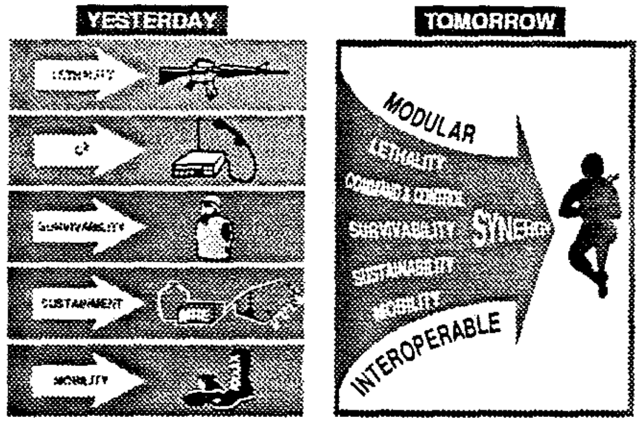
IUSS Executive Summary

The IUSS is based on the philosophy of the Soldier as a System: equipment and other contributors to the soldier's performance must be considered as a synergistic whole, rather than as a series of isolated factors. The IUSS is integrating models which are currently available, but are not now generally used in coordinated analyses. This integration is achieved by means of an IUSS architecture which defines inter-module data flow relationships as standardized interfaces; new models are incorporated into the architecture through the construction of shells which encapsulate the function of the model, deriving the model's data requirements from the information contained in the architecture's underlying data structures, and conversely translating its results to standard interface inputs.

One challenge facing the Army today is to realize the promise of today's technologies for the next generation soldier, in the face of shrinking budgets and rapidly changing geopolitical conditions. The IUSS is designed to help meet this challenge, first by providing the means to assess the combat capability of the Soldier System, and, perhaps, more importantly, by providing a common framework for discussion of Soldier System issues through definition of a standard representation of the Soldier System, one that is shared by everyone from combat operators to the R&D community. To this end, development of the IUSS has been coordinated with multi-agency/multi-service discussions and agreements. These have examined everything from high resolution and human performance modeling issues to questions of potential interface with network applications such as Distributed Interactive Simulation (DIS), and higher echelon models such as Janus.

EVOLUTION OF THE SOLDIER SYSTEM

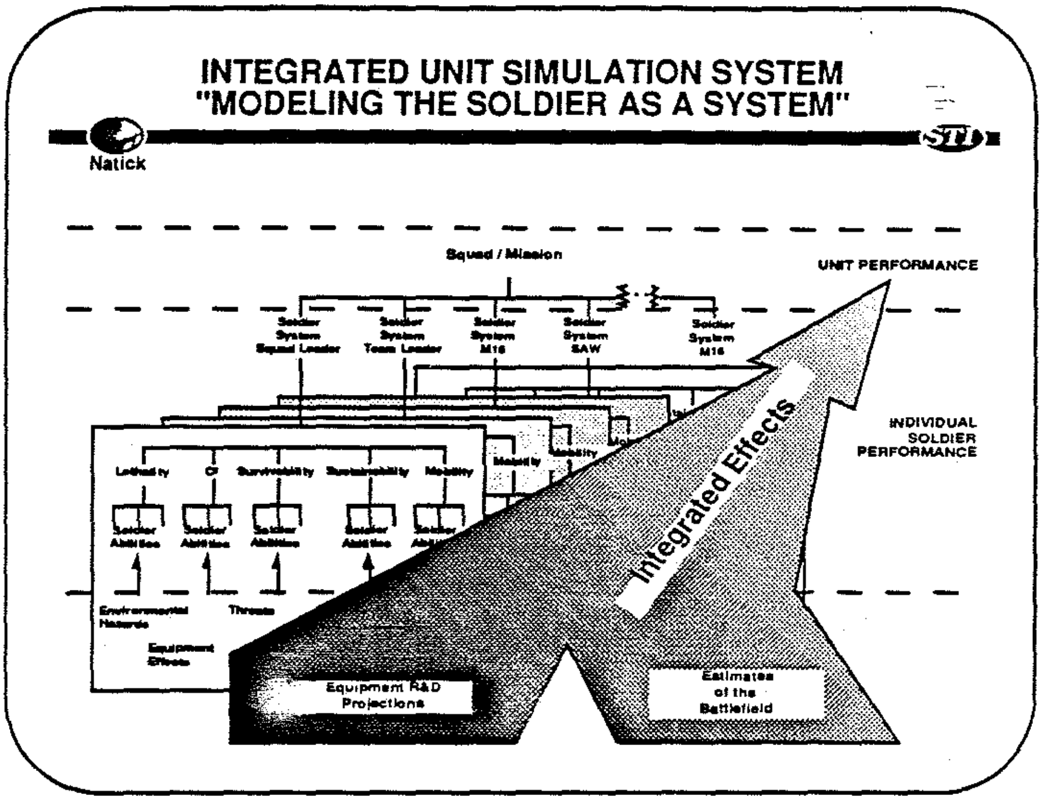
Natick



Evolution of the Soldier System

Historically, equipment for the soldier has been developed through separate, distinct initiatives. Research and development analysis tools have followed this division, with separate models for ballistic weapons, individual protection, etc. While each of these efforts may have been carefully planned and implemented with respect to their individual goals, the end result was still an overwhelming collection of disparate items and a heavily overloaded soldier. The current recognition of the need to treat the soldier as a "Soldier System" comes from the realization that the soldier's weapons, protective gear, and other supplemental equipment must function together as a system, and hence must be designed, evaluated, and maintained as a system.

R&D analysis must support the soldier's mission by facilitating design, construction, test, and fielding of the soldier's equipment. Classical models, with their emphasis on particular aspects of the battlefield (e.g. combat systems, performance degradation, thermal stress) do not provide a comprehensive understanding of a unit's (or an individual's) ability to perform a combat mission. The IUSS, realizing that this ability must be the ultimate measure of merit for decision makers, is designed to parallel the evolution of the Soldier System concept by combining historically distinct models of different aspects of the soldier and his combat systems into an integrated representation of the battlefield.



The IUSS: Modeling the Soldier as a system

Equipment developers must design proposed equipment to act in concert with other components of the Soldier System to achieve the maximum gains possible from system synergism. Equally as import, R&D decisions makers must have some method of a priori demonstration of potential operational benefits, if they are to argue credibly for their share of scarce resources. The IUSS provides tools to help meet this challenge. It is designed to assess the interplay between Soldier System equipment, battlefield stressors, and the soldier himself. The IUSS methodologies simulate the Soldier System at multiple levels of interest, starting with the effects of equipment and battlefield stressors on a taxonomy of human performance abilities and ultimately translating these effects to unit level measures of performance.

As the SIPE ATD and other efforts have discovered, equipment effects are most easily measured with respect to individual abilities, but operational concerns center on mission (i.e., unit) capabilities. The IUSS bridges this gap with a series of model interfaces which integrate data from laboratory tests, field trials, and expert opinion into aggregate measures at multiple levels of concern. The system first calculates the integrated effects of the battlefield environment on the component capabilities of the Soldier System: lethality, command and control, survivability, sustainability, and mobility. Further calculations combine these to assess the performance of individual soldiers, and ultimately estimate measures of the unit's mission performance, merging the contributions from each soldier.

IUSS HIGHLIGHTS

Natick

- Integrated Analysis Environment
- Open, Extensible Architecture for Integration of Multiple Models and Data Bases
- Measures Soldier System Performance as a Function of Small Unit Operability & Survivability
- Flexible Paradigm for Integration of Equipment Effects and Battlefield Stressors at Individual and Unit Levels
- Multi-platform Application Utilizing Graphical User Interface (Unix, DOS, Mac)

The IUSS provides an automated research environment in support of the Soldier as a System. The IUSS architecture is designed to support estimation of individual and unit capability for a broad spectrum of applications, through modular substitution of a wide range of battlefield threat representations, acting in concert with models of soldier equipment and soldiers' performance with that equipment. For a given analysis, each of these factors will be coordinated as part of a simulation scenario, which "sets the stage" for the analysis through the definition of the battlefield environment and specification of unit missions and force composition. This kind of assessment, focusing on Soldier Systems' survivability and operability, can provide a demonstration of the benefits to be derived from current and evolving equipment technologies, as well as a cost-effective tool to examine issues relating to equipment integration and synergisms.

The IUSS is not designed to replace existing analysis tools or capability, but rather to support the analysis process and the application and expansion of such tools through user friendly interface on a wide variety of hardware/software platforms. The approach taken is to automate the analysis project structure and its functions: project definition, scenario definition, simulation, and output analysis, making use of nature man-machine interfaces and the vast potential provided by current hardware and software technologies.

The IUSS focuses on the fundamental relationship between a soldier's psycho-physiological state and the ability to perform discrete mission tasks. Defining module data interfaces in terms of this relationship allows the IUSS to deal with each module in terms of its effects on an underlying data structure - the Soldier System. This facilitates aggregation of effects to unit-level measures of effectiveness, and allows estimation of mission performance and associated costs.

The IUSS methodology does not impose any specific format for the soldier capability data structure, although it does require consistency within the elements of a particular analysis scenario. The number and exact definition of the abilities comprising the capability data structure components can thus be adjusted to fit the needs of a given analysis: the sensitivity of the performance models employed, the availability of supporting data, the types of tasks and the equipment factors to be studied, and the resolution and fidelity of analysis required.

FY92 ACCOMPLISHMENTS

Natick

- Production Display of IUSS Demonstration Prototype
  - 60th Annual MORS Symposia
  - Soldier System Exposition
- Construction of Model / Methodology Data Base
  - Literature Search Results
  - Methodology Enhancements
  - Coordination of Soldier System Modeling Efforts
- Analytic Support Initiatives
  - SIPE ATD
  - TEISS TOD (Natick)
  - Dismounted Warrior Battle Lab (USAIS)

FY92 Accomplishments

The IUSS was last presented to the TBESC in April of 1992 as part of a series of briefings on Natick's Analytical Support to the Soldier as a System. Since that time, the majority of Natick's modeling efforts, many of them continuations of initiatives presented in those briefings, have been associated with the IUSS in one way or another.

A demonstration prototype of the IUSS, originally developed as a means of soliciting user/analyst feedback, has been gradually evolving into the first generation system. This prototype has been widely viewed at such forums as the 60th annual symposia of the Military Operations Research Society and the Soldier System Exposition. The current version will be presented later on in this briefing. Beta testing of the first generation system is scheduled to begin in the second quarter of FY93.

The demonstration prototype concentrated on issues of user interface, input data requirements, and types of output analyses required. This user interface will communicate with a library of models through the IUSS architecture. Considerable effort to date has been directed to the evaluation of candidate models/methodologies, and to the adaptation and enhancement of these to meet the requirements of IUSS applications. This effort has proceeded in concert with Natick's coordination of Soldier System Modeling at the direction of the TBESC and in reaction to the favorable response of the modeling community.

The effort has also played a key analytical support role to a number of other endeavors, must notably the SIPE ATD, Natick's response to PM Soldier's TEISS trade-off determination requirements, and the Infantry School's development of the Dismounted Warrior Battle Lab.

IUSS DEMONSTRATION PROTOTYPE

Natick

- Mission Task Networks Modeled on ARTEP Battlefield Operations System Tasks
- Geographical / Time Links to Task Network Nodes
- Selection of Unit / Soldier Attributes
- Output Data Reduction / Analysis
- Books and Bibliographic Support Data Base

IUSS Demonstration Prototype

IUSS simulation scenarios are built around the concept of the unit (e.g., squad or platoon) and the unit's mission. Missions are represented as networks, with network nodes fashioned after the Battlefield Operating Systems Tasks (BOS-T) as defined in the Army Training and Evaluation Program and Mission Training Plans (ARTEP/MTPs). This is done to promote commonalty of both language and structure for IUSS simulations.

Many of the process network models used for industrial simulations are concerned only with the allocation and consumption of resources and model process nodes by drawing required process time from the appropriate statistical distribution. By contrast, IUSS task nodes must be able to represent the effects on task performance from the highly dynamic conditions referred to as METT-T (Mission, Enemy, Terrain, Troops, and Time available). For this reason, the task network nodes require explicit links to geographic features and clock time constraints. The demonstration shows these features and additionally illustrates the operation of the graphical user interface (GUI) for the definition of soldier and unit configuration.

The IUSS is designed to make maximum possible use of commercial off-the-shelf (COTS) software. The prototype demonstration shows the use of Microsoft Excel® to format and reduce simulation results. The IUSS can write simulation result histories to files compatible with such COTS software and thus has readily available a large variety of tools to analyze the raw simulation data.

CONSTRUCTION OF MODEL / METHODOLOGY DATA BASE

Natick

- Structured Definition of the Soldier System
- Inventory of Soldier System Models / Simulations / Algorithms
- 50+ Abstract Citations for BOOKS
- Ballistic & Chemical Casualty Simulation Mechanism Model Enhancements
- Human Performance Taxonomy
- Natick Human Performance Modeling Conference
- Natick High Resolution Modeling Requirements Conference
- JBESC Soldier System Modeling Working Group Support
- JANUS / CASTFOREM Interface Development

Construction of Model/Methodology Data Base

Methodology development for the IUSS has been based on the construction of a top-level structured definition of the Soldier System, along the lines of the Soldier System Hierarchal Model, and based on the five capability areas of the Soldier System as identified by the Soldier Modernization Plan. This structured definition of the Soldier System has proceeded in parallel with the development of a taxonomy of human performance abilities which affect those capabilities; both of these will be used in concert to translate the effects of battlefield stressors to measures of Soldier System performance.

Natick has also applied research done for the IUSS towards such collateral work as the 1992 Inventory of Soldier Systems Models/Simulations/Algorithms. BOOKS has been suggested as a possible tool for Inventory data base support. BOOKS currently contains the references for the core models/methodologies being adapted to the IUSS.

The IUSS has directly supported model development for improved simulation of such ballistic casualty mechanisms as flechettes and blast effects, as well as construction of methodologies for enhanced representation and display of chemical munitions' effects.

These efforts have been heavily coordinated within the modeling and simulation community This coordination has also laid the groundwork for future use of IUSS results as high resolution inputs for such models as JANUS and CASTFOREM.

ANALYTIC SUPPORT INITIATIVES

Natick

- SIPE ATD Scenario Development
  - JANUS Simulation of SIPE Equipped Soldier
  - Data Collection / Evaluation Methodology Development
- TEISS TOD (Natick)
  - Data Collection Formats
  - Inter-Component Synergy Analysis
- Dismounted Warrior Battlelab (USAIS)
  - Coordination of Scenario-Based Threat Analysis for the Future Soldier System
  - Model Testbed Plan

Analytic Support Initiatives

From its inception, the IUSS has been closely tied to the SIPE program. Concepts of how SIPE would be used in field exercises at the Advanced Technology Demonstration (ATD) have influenced the development of IUSS scenarios and mission profile representations. Conversely, IUSS methodologies have provided a basis for SIPE ATD data evaluation tools.

The IUSS provided a further analytical foundation when PM Soldier imposed a requirement on Natick to support a trade-off determination (TOD) for the successor to SIPE, The Enhanced Integrated Soldier System (TEISS). IUSS data formats were adapted to meet TOD format specifications, and used to collect data from across the entire spectrum of Natick's technology areas. Perhaps even more important, the IUSS concept of integrated effects provided a framework for the evaluation of technology transfer and inter-technology cross-over effects and synergisms.

The IUSS has also played a key role in the current formation of the Dismounted Warrior Battle Lab at the US Army Infantry School. The Battle Lab is currently planning on adopting the IUSS as a core simulation capability, serving as a model testbed, and further supporting the IUSS as a source of field data and a conduit for operational feedback.

DEMONSTRATION

Natick

- Selection of Unit / Soldier Attributes
- Mission Specifications
- Dynamic Representation of METT-T
- Analysis of Results
- BOOKS

Demonstration
This demonstration provides a representative sample of the design features of the IUSS. The demonstration is based on a task network taken from the SIPE ATD STX's, and illustrates how analysis performed by the IUSS can support such initiatives as the SIPE ATD by exploring scenario features and additional scenario variants beyond the scope of the ATD itself. For example, the IUSS allows estimation of casualties and examination of questions of survivability which cannot be demonstrated under peacetime constraints.

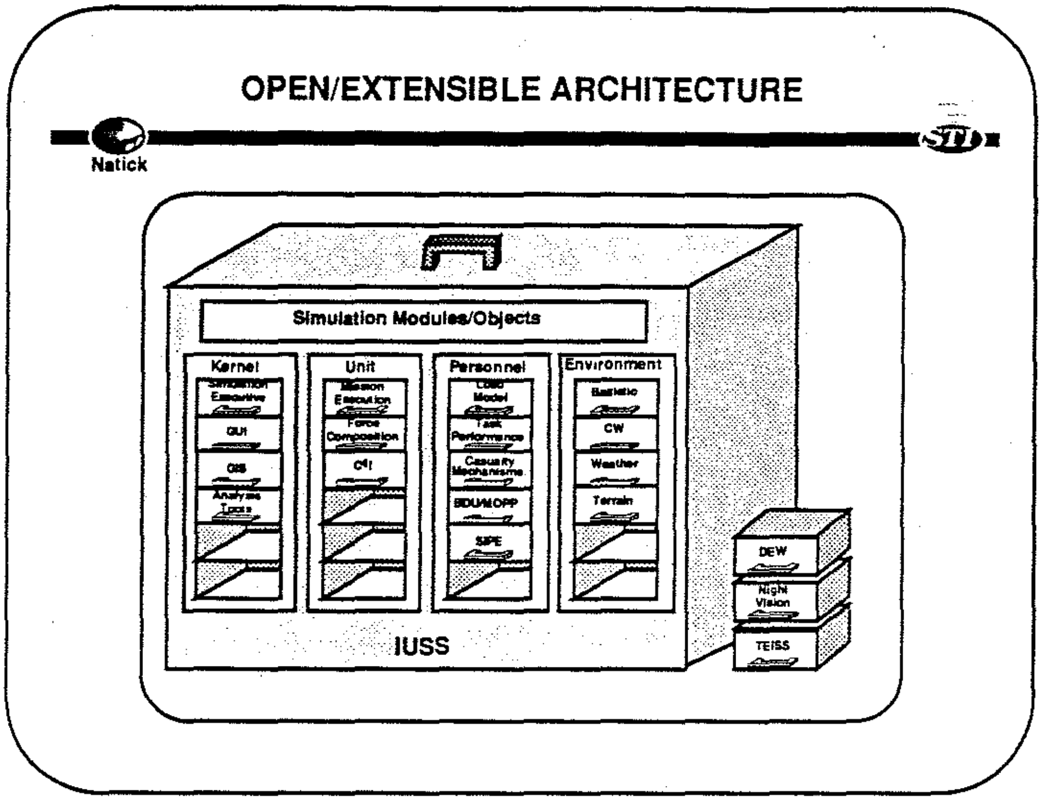
Selection of Unit/Soldier Attributes
The IUSS representation of the battlefield begins with the definition of scenario components, including the designation of each soldier's equipment, his protective posture and physiological condition. Collections of soldiers are configured into units and unit specific equipment is assigned.

Mission Specification
The planned mission of the unit is laid out by the analyst as a task network. Depending on the analysis requirements, these networks can be relatively straightforward linear collections of tasks, or complex constructions of sub-task networks. The task nodes themselves allow the analyst to explore a variety of measures of task performance and to adjust constraints of timing, unit strength, and other features of METT-T.

Dynamic Representation of METT-T
The tasks are linked to geographical data bases, which can also be adjusted depending on the resolution of information required to adequately represent the phenomena being simulated, everything from simple flat earth terrain to complex topographical and cultural terrain details. As the simulation proceeds, the battlefield environment is dynamically updated to represent the progress of the battle. For example, chemical munitions may be simulated by time and geographically varying contamination patterns, or ballistic hazards may be represented as stochastic events affecting the simulated soldiers.

Analysis of Results
The IUSS is also designed to make maximum possible use of commercial off-the-shelf (COTS) software. Illustrated here is the use of Microsoft Excel® to format and reduce simulation results. The IUSS can write simulation result histories to files compatible with such COTS software and thus has readily available a large variety of tools to analyze the raw simulation data.

BOOKS
BOOKS, developed for the IUSS, provides an automated relational data base tool to search for information on the references to the methodology and data used to support IUSS development and the construction of scenario inputs (and associated variants) for specific analyses.

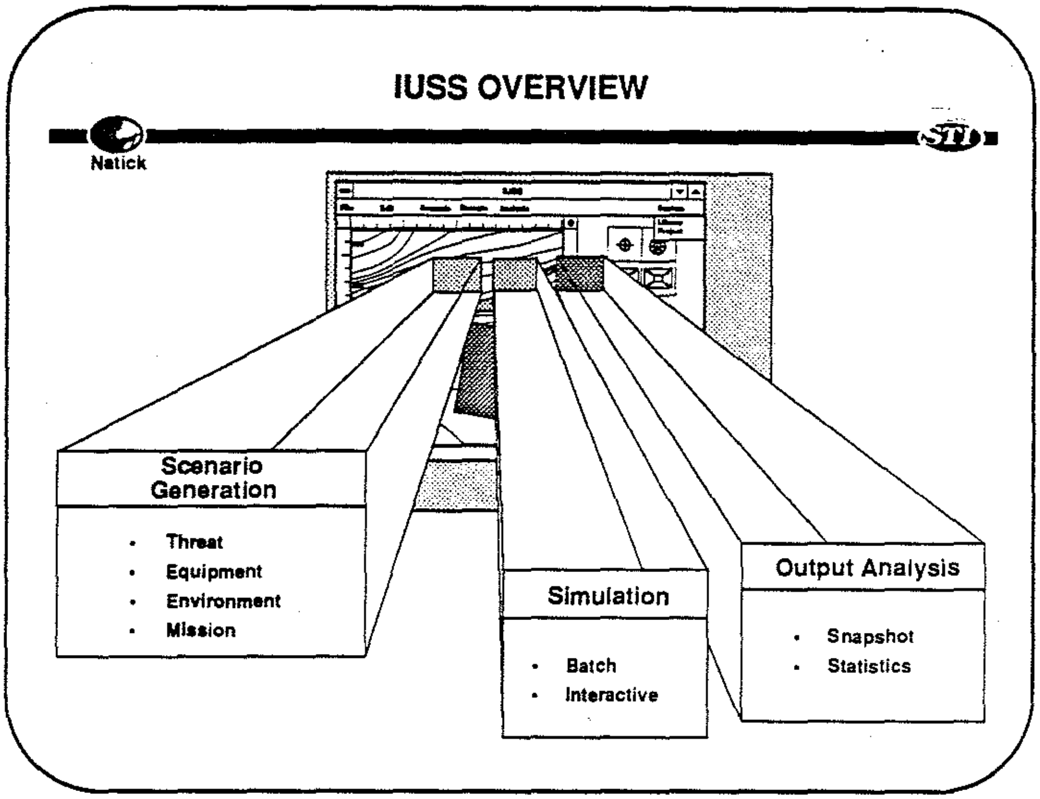


THE IUSS OPEN/EXTENSIBLE ARCHITECTURE

As stated earlier, the IUSS design is based on an architecture which is both open - transportable to multiple hardware/software platforms, and extensible - capable of expansion through the addition of new functional modules. This extensibility is facilitated by the object oriented programming paradigm, which supports encapsulation of the functionality of each module, but also allows easy module replacement and expedites inter-module data flow through overloading of function names. The open architecture will permit a unified representation of the factors relevant to a given analysis by exercising appropriate objects/modules and allowing them to interact with one another.

The IUSS will integrate models which are currently available, but are not now generally used together in coordinated analyses. The IUSS architecture defines inter-module data flow relationships as standardized interfaces; new models are incorporated into the architecture through the construction of shells which encapsulate the function of the model, deriving the model's data requirements from the information contained in the architecture's underlying data structures, and conversely translating its results to standard interface inputs.

Initially, the IUSS will concentrate on those models needed to provide near-term assessment of proposed individual Soldier Systems (e.g. SIPE). However, as shown here, the IUSS architecture is designed to facilitate easy inclusion of additional or new models/methodologies, for example, the effects of new soldier equipment, novel threats/hazards, or theater-specific considerations.



IUSS OVERVIEW

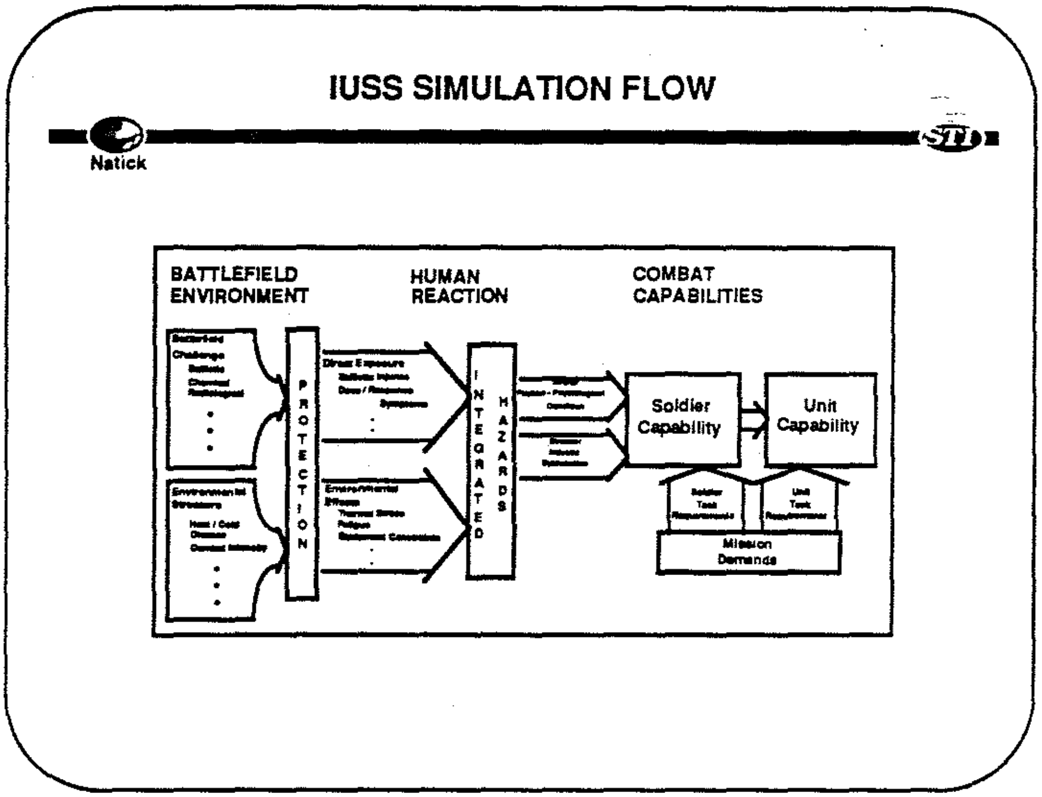
The IUSS is designed around the concept of an analysis project, which could be anything from a very small "quick and dirty" effort (e.g.; estimation of soldier travel time over a given terrain set) to much larger multi-year R&D support analyses. A typical project would incorporate an extensive case matrix with a number of different measures of effectiveness, and multiple parametric variations of factors of interest. Such a study would be supported by a library of data bases containing canned inputs, results of previous studies, bibliographic sources, etc. Support and management of such a library or libraries are important functions for the IUSS.

An analysis project has three primary components:

Scenario: System elements to be analyzed, and the context in which they will function. Scenarios are comprised of such elements as the threat, the simulation environment, unit mission and Soldier System equipment.

Simulations: Models describing scenario outcomes. The IUSS will allow execution of scenarios either interactively (pausing to examine intermediate results), or in batch mode (generally a number of scenario variants executed sequentially).

Output Analysis: snapshot views of simulation progress, examining status of systems, the environment, or other factors of interest, or accumulated statistics, e.g., variables over time, Monte Carlo variation within a single scenario, ANOVA or other techniques across scenario variants.



IUSS SIMULATION FLOW

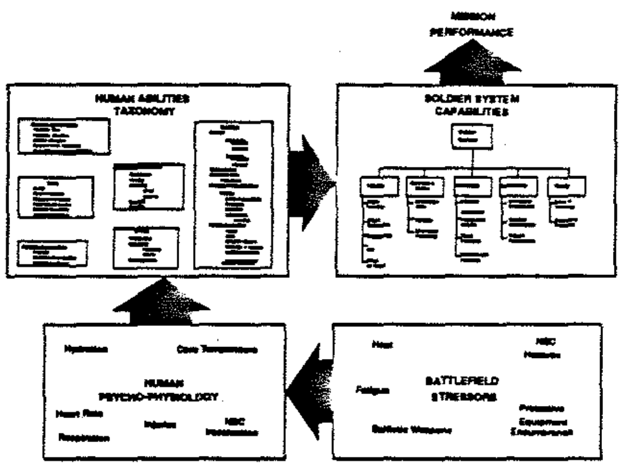
The IUSS implements its analysis scenarios as a series of time and event-driven model calculations, interrupted as required to provide output "snapshots" displaying results of interest. Each of these "snapshots" examines the dynamic interaction of the scenario components, employing three basic update phases as shown here. The first of these defines the basic features of the battlefield environment, calculating time-dependent challenge profiles for chemical agents, conventional munitions, or other battlefield stressors.

The second phase determines each individual's exposure to these stressors and calculates an appropriate level of human response by relating stressor effects with psycho-physiological condition. Specific levels of each hazard or stressor are correlated with their consequences on human performance, describing each soldier as a set of constrained human performance abilities.

In phase three, these constraints on the soldier are compared with mission task requirements to determine the soldier's capability to perform his mission tasks. Individual performance measures are in turn aggregated to unit mission measures of effectiveness, which are the ultimate metrics of concern to the IUSS target audience.

PERFORMANCE METHODOLOGY OVERVIEW

Natick



PERFORMANCE METHODOLOGY OVERVIEW

The ultimate objective of Natick's operations research analysts is incorporation of models of the Soldier System into a comprehensive simulation of the battlefield. Such a simulation would represent individual and unit performance with a multi-phase approach. The first of these phases defines the basic features of the battlefield environment, calculating time-dependent challenge profiles for chemical agents, conventional munitions, or other battlefield stressors. The next phase determines each individual's exposure to these stressors and calculates an appropriate level of human response by relating stressor effects with psycho-physiological condition. Specific levels of each hazard or stressor are correlated with their consequences on a human abilities taxonomy describing each soldier as a set of constrained human performance abilities. These constraints are fed into a model of soldier task capabilities (e.g., the Soldier System Hierarchical Model shown here) where those capabilities evaluated in the context of specific mission task requirements, providing an estimate of the soldier's overall capability to perform those mission tasks. Individual performance measures are in turn aggregated to unit mission measures of effectiveness, which are the ultimate metrics of concern to the IUSS target audience.

THE HUMAN PERFORMANCE CHALLENGE

Natick

PROBLEM: We Don't Know The Relationship Between:

- Stressors - Human Response
- Human Ability - Soldier System Capability
- Soldier System Capability - Battlefield Performance

PRESENT BEST APPROACH:

- Explicitly List Simplifying Assumptions & Factors Affected
- Define Sensitivity Of Results To Input "Estimates"
- Direct Research To Key Data Gaps
- Provide Logical Audit Trail Of Decision Process
- Quantify Relative Differences ("Capability Deltas") Between Different Soldier System Concepts

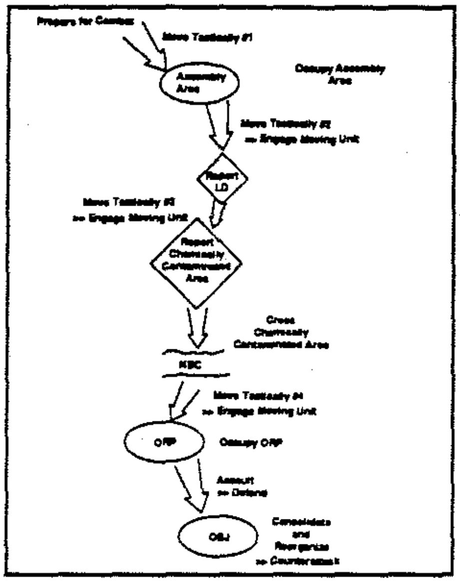
The Human Performance Challenge

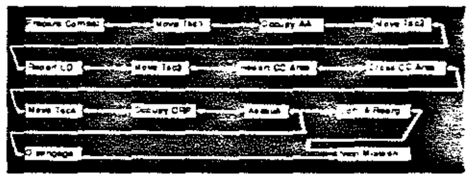
The difficulty with modeling human performance is that there are many complex relationships at every level which are poorly understood (if at all). For many years, these problems were generally placed in the category "too hard to solve". Unfortunately, many of the decisions in the R&D arena require at least implicit estimates answering these questions; ignoring them in the hope that they will go away is not an acceptable alternative. Estimated answers are usually based on some sort of "gut feel", but are not in general well documented, and are seldom defensible if closely examined. The present best approach to attacking (if not solving these problems) lies in explicitly recognizing the simplifying assumptions which must be made to provide first cut "rough" estimates (or "engineering estimates"), and further identifying the most important factors affecting results. This is an area in which the "model-test-model' paradigm can be useful. Models and simulations can be used to suggest key areas for laboratory experiment and field trials, the result of these activities can be then used to refine the models and an interactive process is initiated which will lead to more carefully documented and hopefully "better" estimates.

It is probably unrealistic to expect models and simulations to ever achieve absolute predictive validity, in the sense that they could be used to accurately determine the outcome of future combat. However, they can still be useful in measuring "relative" effects of equipment or other combat associated factors, providing capability deltas as measured from some accepted baseline valu

EXAMPLE MISSION TASK NETWORK

Natick

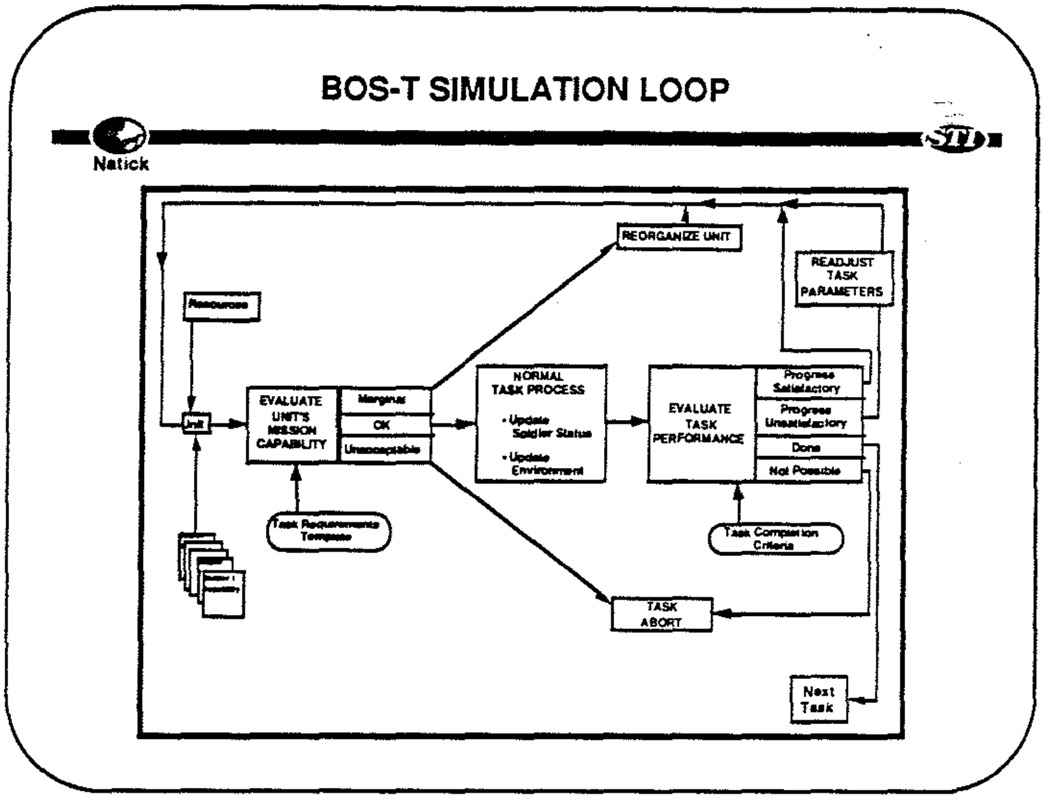




Example Mission Task network

As mentioned above, the IUSS models combat as networks of BOS-T nodes, ensuring a common framework for analysis, training, and combat operations, and enhancing communication between all the players. Shown here are representations of the tasks of Operation Crder 192, one of the situational training exercises (STXs) for the Soldier Integrated Protective Ensemble (SIPE) Advanced Technology Demonstration (ATD). The STX mission is represented in the IUSS as a simulation network, each of whose nodes represent a BOS task. This design permits assessment of operational effects at multiple levels of resolution: from each Soldier System component and specific battlefield stressor, to the performance of the individual soldier, and to the aggregate capability of the soldier's unit.

With the IUSS, for the first time in history <u>all</u> of the players in the soldier modernization process : combat developers, training developers, and materiel developers will be working off of the same analytical data base. Players will be able to "tinker" with the various parameters defining their soldier system concepts, playing the "what ifs" through computer simulation. In particular, the IUSS will facilitate implementation of the "Model-Test-Model" paradigm: the use of computer simulations to refine and focus operational test plans and the subsequent use of the test results to refine and improve mathematical and computer models.

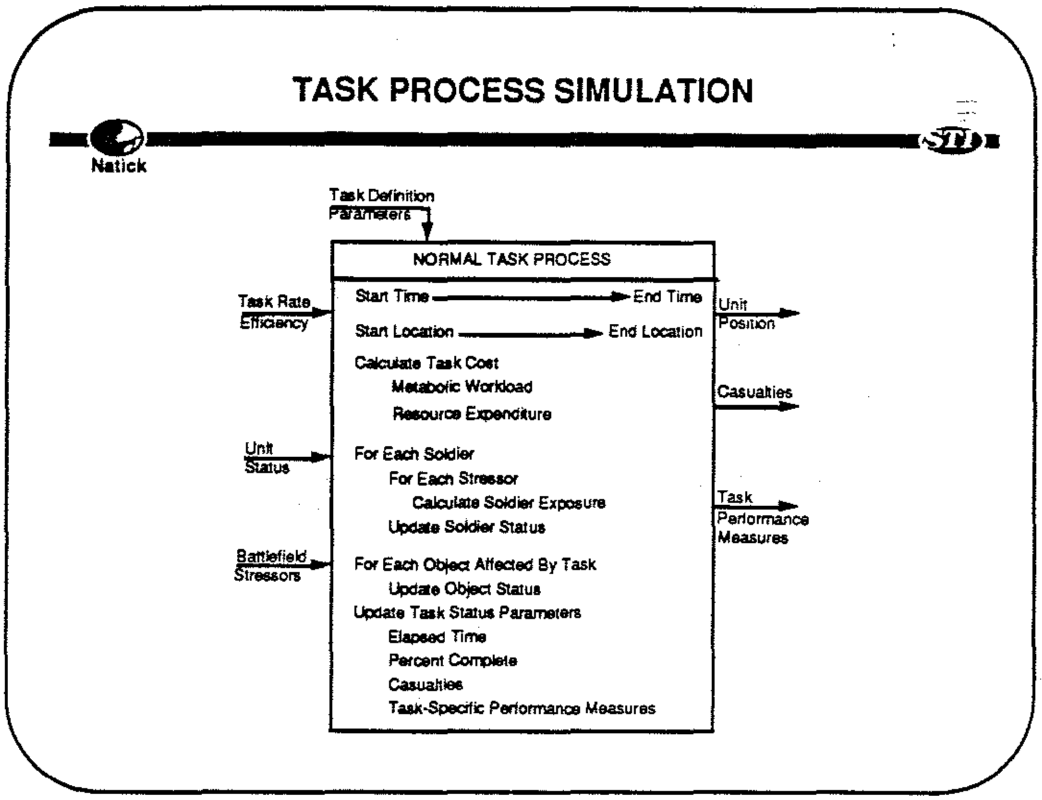


BOS-T SIMULATION LOOP

The Soldier System Hierarchical Model must also be applied to some context of mission tasking, such as a task network structure in which the functional network nodes simulate the Battlefield Operating Systems and Tasks (BOS-T) functions of the US Army Training and Evaluation Program.

As shown here each network task node is basically a simulation loop. The primary node input is the unit resource stream, representing individual soldiers and equipment assigned to the simulated mission tasks. The node loop begins with an evaluation of the assigned unit's ability to perform the given task. The unit may be fully mission capable, in which case the normal simulation process for this task type is initiated. Alternatively, the unit may require some form of reorganization (e.g., reassignment of unit duties to alternate personnel, replenishment of unit resources, addition of new personnel) before proceeding with task performance. In the worst case, the unit may be unable to continue, necessitating a task abort and mission failure.

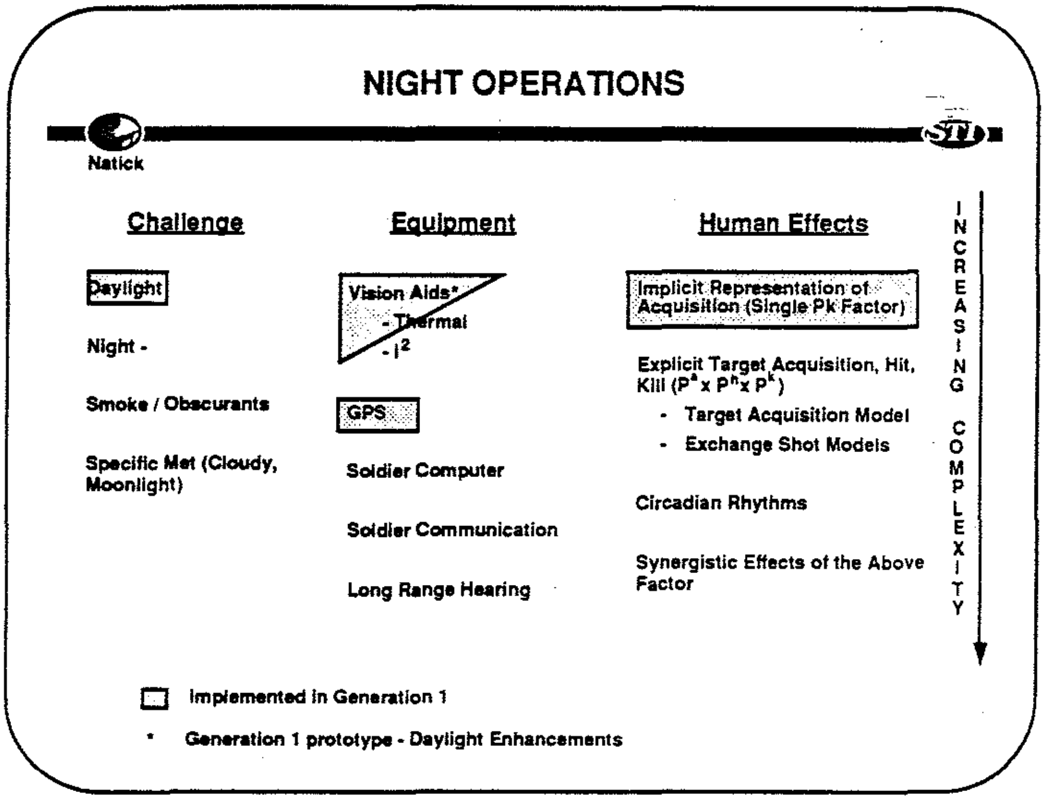
For each iteration of the loop, evaluation of unit capability results in the assignment of performance parameters (e.g., rate, efficiency) followed by incremental simulation of task processes. At the conclusion of each iteration the system evaluates the task progress. If the task is complete, the simulation proceeds to the next network task. If the task is incomplete, but progressing normally, the loop for this task node is repeated, evaluating current unit capability (as updated after performance of the simulation process during the last time step) to continue with the task. If the task is not proceeding within defined parameters (e.g., on a move tactically task if the directional errors induced by navigational difficulties have drawn the unit off course), some readjustment of task parameters may be required (e.g., the unit commander must calculate a new course). If the task performance is not correctable (e.g., the unit is hopelessly lost) a task abort is activated.



TASK PROCESS SIMULATION

The core of the above network task is the task process simulation, the actual model of the task function as opposed to the logics which determine process alternatives and functional parameters. The task process simulation implements those phases of the performance methodology which modify the status of the soldiers simulated or the battlefield itself. The process begins by calculating the performance costs of the task, examining the battlefield environment for the stressors affecting the unit's soldiers, updating the status of the soldiers based on the effects of those stressors and the task performance costs, and in turn updating the status of the battlefield in response to the results of task performance.

The task process approach follows the object oriented programming paradigm, allowing simulation of the task as an encapsulated function, a "black box" which can be replaced according to the resolution requirements of a given analysis, and the fidelity of available data to support that process. This also allows the incremental inclusion of the representation of multiple stressors, and the replacement of specific process models as more sophisticated (and hopefully more accurate) models become available.

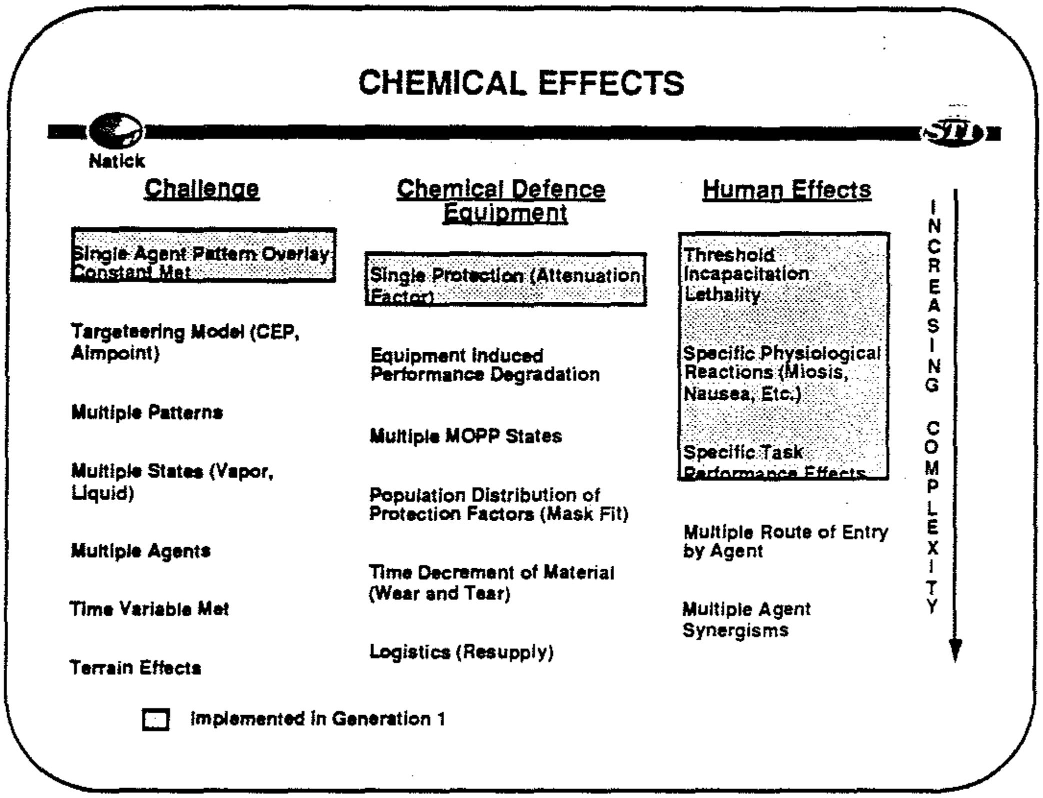


NIGHT OPERATIONS

These next two slides will illustrate the approach taken for IUSS development by detailed examination of a couple of different areas: chemical effects and night operations. For each of these areas, the phenomena we wish to simulate can be broadly divided into three categories: estimation of the battlefield effects (threat, challenge, environmental factors), representation of Soldier System equipment designed to deal with those effects, and finally how both of those factors manifest themselves in terms of what happens to the human and Soldier System performance.

Night operations are one aspect of a broader spectrum of problems inhibiting vision and human sensory perceptions. Modeling of these features is complicated by assessment of both performance degradations as induced by the features in the environment and the potential for enhancements provided by some equipment items that can increase performance well beyond the capabilities of a normal unimpaired individual. Many of these features require an explicit representation of the Soldier System lethality capabilities: acquisition, fire, hit, kill.

The shaded items will be implemented in the 1st generation IUSS prototype. The use of vision aids under daylight conditions are being implemented in the 1st generation IUSS prototype to support the analysis of the SIPE ATD.



CHEMICAL EFFECTS

As in the previous slide, representation of chemical effects needs to consider the estimation of battlefield challenge, representation of defensive equipment, and effects on the human. For each of these categories, a given simulation has to chose a level of complexity appropriate to the requirements of the desired analysis, and supported by available data and subject to the constraints of time, money and personnel. This slide shows the features chosen for implementation of chemical effects in the first generation prototype of the IUSS. The choices were driven by the focus on the estimation of Soldier System capability as reflected by the human performance of the individual dismounted soldier. Explicit representation of specific human performance factors was deemed of higher priority than representation of a wide variety of threat types.

IUSS GENERATION 1 FEATURES

Natick

- Explicit Soldier System Performance Effects on Mission Task Networks
- Dynamic Ballistic, Chemical, Thermal Casualty Mechanism
- Explicit Position / Movement of Blue Forces
- Data Base Tool
- Formatted Simulation Output Files

IUSS GENERATION 1 FEATURES

This slide identifies some of the more important features of the first generation IUSS prototype.

The first generation IUSS provides explicit modeling of Soldier System performance effects on mission tasks, with those tasks following the general structure of the Army Training and Evaluation Plan (ARTEP) Battlefield Operating System Tasks. Currently the IUSS provides mission task networks which represent those Mission Training Plan (MTP) tasks identified for use in the SIPE ATD Field Demonstration. Additional mission task networks can be constructed by using the task network engine.

Dynamic ballistic, chemical, and thermal casualty calculation mechanisms have been built into the 1st generation prototype. Explicit blue force position and movement and red-on-blue indirect fire are also included.

A data base tool and formatted simulation output files have been included in the IUSS prototype to manage the data infrastructure developed during the IUSS development in support of the SIPE ATD.

Cooperative efforts are currently under way between TRAC-WSMR, Natick, and STI to allow the exchange of terrain and systems data between JANUS and IUS

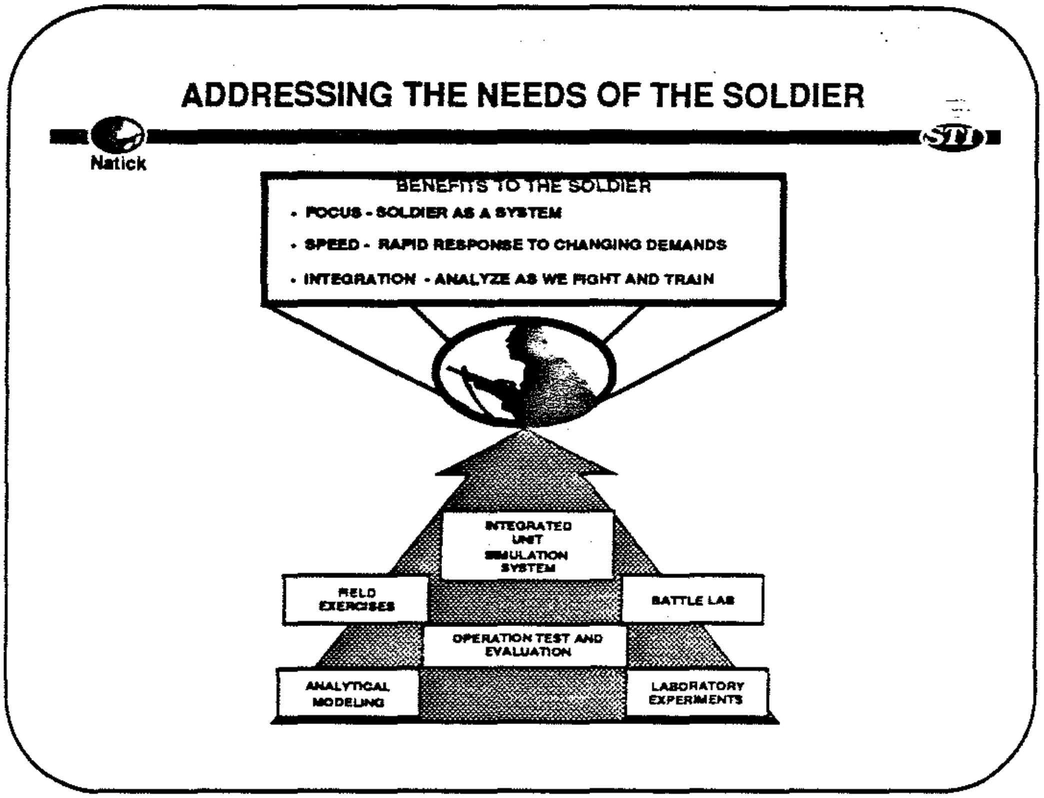
PLANNED GENERATION #2 FEATURES

Natick

- Explicit Red / Blue Interaction
- Terrain Effects
- Explicit Target Acquisition
- Scenario Targeteering Model
- Dynamic MOPP States
- Complete Equipment Induced Degradation Effects
- Population Distribution of Protection Factors
- Night, Smoke, Obscurants
- Complete Night Vision Effects

IUSS FUTURE GENERATION PLANNED FEATURES

The planned second generation of the IUSS will encompass more areas of model complexity such as those discussed above, and additionally will expand the capabilities of the user interface and data management tools. Features currently planned include more dynamic interaction between red and blue forces, with explicit calculation of target acquisition and engagement. The second generation IUSS will also incorporate a scenario targeteering model to expedite study of threat weapon effects and corresponding defensive reactions such as modeling of dynamic MOPP states, and modeling of operations in night, smoke and obscurants. It will also model population distribution of protection factors and complete the representation of the effects of equipment induced performance degradation and night vision effects.



Addressing the NEEDS of the Soldier

The value of analytical tools, such as the IUSS, can ultimately be measured only in terms of their benefits to the soldier. Historically products from the R&D community have addressed R&D perceptions of the soldier's need, all to often this perception has been at odds with the combat reality. A key component of the IUSS philosophy is the need to provide realistic simulations of the operational environment, and, additionally, to describe that environment in the same language used by combat soldiers as they train and fight

The IUSS is intended first and foremost to assist all the players in the R&D arena in focusing on the real needs of the Soldier System. The IUSS has been designed to be accessible to both the developer and the user, to facilitate the exchange of information on projected developments. For example, the IUSS supports the demonstration of proposed equipment or other innovations as virtual prototypes, computer simulations of operational concepts which can be viewed in realistic combat settings. Construction of virtual prototypes is a quick, cheap method for early assessment of concept viability and the definition of requirements, and additionally provides a strawman to elicit end user feedback. Such a conduit for information will ensure that the R&D community is more responsive to the operational community, with products more focused on their needs and less time required to field those products.

IUSS APPLICATION GOALS

Natick

- Develop Standard Definition of the Soldier as a System with Performance Baselines
- Quantify Soldier Capability Deltas to Determine Optimal Resource Allocation Alternatives Based on Soldier System Component Life Cycle Constraints and Changes to the Soldier System
- Provide Design Criteria to Equipment Developers

IUSS Application Goals

Natick has established near-term goals for the application of the IUSS. The most pressing of these is the completion of the structured definition of the Soldier System. The IUSS currently incorporates an adaptation of the hierarchal representation of the Soldier System which provides an adequate representation of the highest level Soldier system functions, but this definition is incomplete without a set of representative missions, associated tasks, and measures of performance with which to define the baseline Soldier System.

Once a baseline as been defined, R&D concepts can be simulated and assessed in terms of capability deltas: deviations from baseline measures. These in turn will provide valuable input to decision makers faced with the question of how to best assign R&D resources to optimize the capabilities of the Soldier System. The same sort of relative comparisons can be used in front end analyses to trade-off potential benefits in one capability area against effects in another, as for example in the balancing of capability versus risk in the design of personal protection.

IUSS NEEDS

Natick

- Data
- Models/Estimates of Soldier Performance and Survivability as a Function of Specific Stressor Levels
- Models Allowing Detailed Results of Laboratory Testing, Field Testing, Item / Component Modeling, and Studies to be Aggregated into Data Usable by Standard Composite Force-on-Force Models

As is true for any model, results from the IUSS will be only as good as the input data which drive them. Current development efforts have already identified a number of critical data gaps which must be filled before roust analyses can be carried out. It is encouraging to note that many of these gaps are be addressed at present. In particular, the SIPE ATD is producing a wealth of information on descriptive characteristics of both current soldier configurations and those associated with SIP prototype equipment. Similarly, the TEISS TOD is beginning the effort to characterize the Block Two Soldier.

As discussed above, the need for both data and methodology to support estimates of human performance as affected by battlefield stressors is particularly acute. While the constraints of peacetime testing make it difficult, if not impossible, to obtain many of these data, there is hope for transference of data using the virtual casualty methodology currently being explored by the Defense Nuclear Agency and others. This may permit, for example, extrapolation of the effects of chemical agent intoxication by comparison with known performance effects of other intoxicants such as alcohol. Judicious use of the model-test-model paradigm may allow some infusion of human experimentation in such areas as heat stress and fatigue. The virtual casualty paradigm would again allow extrapolation to other stressors or to more severe effects at levels which would be unsafe for human tests.

Finally, while the IUSS, at least in the near-term, will concentrate on individual and small unit performance, models of activity at higher echelons are beginning to see the need for higher resolution representation of combat phenomena than are achievable within their current structure. The IUSS appears capable of providing this resolution, but work still needs to be done on appropriate methodologies for aggregating IUSS results to input data compatible with the input requirements of composite combat models. Natick has submitted a proposal to the Defense Modeling and Simulation Office (DMSO) for a concept known as "HYPERGATE" which in essence provides for intelligent filtering of data between models of differing levels of resolution.

SUMMARY

Natick

INTEGRATED UNIT SIMULATION SYSTEM

OBJECTIVE:	R&D FOCUSED ON THE SOLDIER
PHILOSOPHY:	ANALYZE AS WE FIGHT AND TRAIN
RESULT:	SCIENTIFIC FOUNDATION FOR THE SOLDIER AS A SYSTEM

Summary

The IUSS was designed to facilitate the application of the R&D process to the production of improved equipment for the soldier. However, the concept of the Soldier System is not well supported by considering equipment in isolation, and consequently, for the IUSS to achieve its objective, it must also support examination of issues associated with training, doctrine, and operational concerns, both in-and-of themselves and as interacting factors.

Coordination of the R&D process, across the boundaries of materiel, training, and combat developments, requires a common language and a single standard framework for viewing Soldier System issues. The IUSS, by adopting the form and methods of the Army training and evaluation plans, expands the concept of "Train as we fight and fight as we train" to include "Analyze as we fight and train".

The IUSS is resulting in the formation of a structured definition of the Soldier System. This structured definition includes the construction of baselines for Soldier System performance and explicit recognition of the complex relationships between the multiple facets of the modern battlefield. This process provides a solid scientific basis for Soldier System studies and analyses, and is a critical element in optimizing the combat capability of the next generation soldier.

This document reports research undertaken at the U.S. Army Natick Soldier Research, Development and Engineering Center, Natick, MA, and has been assigned No. NATICK/ TP-10/002 in a series of reports approved for publication.